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Obsolescence Prediction Tool (OPT)

Abstract

The Obsolescence Prediction Tool (OPT) software developed by the Naval Supply Systems Command under a Small Business Innovative Research (SBIR) contract with Stottler-Henke Associates, Inc. is a software application designed to provide an automated process to monitor obsolescence of weapon systems via parts status and technology trend forecasts. In its development and evolution, OPT has incorporated the methodologies and expertise from prediction experts in order to provide a flexible, responsive automated tool to assist in obsolescence evaluations.

By automating these capabilities, OPT provides multiple benefits. First, weapon systems managers can receive early proactive notification of parts obsolescence thereby allowing for intervention of potential problems. Second, the programmed methodologies provide consistent predictions across multiple related case scenarios. Third, individual program assessments can be conducted with the knowledge that the analysis is based on consistent methodologies. And fourth, automated analysis provides for larger volumes of data to be evaluated and for a higher frequency of analysis to occur.

While not fully deployed to DoD users, the OPT has been well received in the obsolescence community. The obsolescence community's excitement is rooted in the OPT's ability to be a viable tool offering existing obsolescence workers an additional check on assessments, as well as providing information for those managers considering the use of prediction tools for the first time.

Introduction

When a part is no longer economical to produce, manufacturers will shut down product lines and move on to more profitable items. Depending on the specific type of technology, electronic components typically have a very short production life. As niche producers enter and exit highly specific markets, some product lines become divorced from a viable or reliable production stream. Regardless of the reason, program managers and support technicians are left with the endless task of resolving specific obsolescence problems. Many resolutions exist. They vary in the levels of risk, cost, and complexity. There is one constant in this world of variance and uncertainty: advanced warning can greatly aid obsolescence mitigation.

System health analyses, predictive tools, data warehouses, and case tracking can all help bring more accurate and timely information to the obsolescence community. NAVSUP has developed the OPT to offer Program Managers and technical support staff advanced warnings of obsolescence-related risks in their systems. This paper will describe the OPT in its current state, in its likely future state, and where it fits into the big picture of obsolescence mitigation.

Current OPT

The current OPT was a deliverable within a second phase Small Business Innovative Research (SBIR) contract. Delivered in December 1998, the prototype tool was designed to help weapon system managers monitor the obsolescence status of weapon systems (Ong, 1999). The OPT's design goals included the following:

- to predict obsolescence of integrated circuits (ICs) by part number

- to predict obsolescence of ICs by weapon system parts list
- to predict obsolescence of ICs by technology type
- to provide rapid access to parts information
- to leverage technology trends forecasts data
- to apply the methods established by NAVAIR's Microcircuit Obsolescence Management (MOM) group (now defunct)
- to support future change with flexibly configured databases and algorithms.

The main goal of the current OPT's design is to improve Diminishing Manufacturing Sources and Material Shortages (DMSMS) management through the implementation of a full-scale, proactive parts obsolescence prediction tool (SHAI, 1). It was designed to support obsolescence prediction, parts look-up, technology forecasting, and weapon system navigation. Using combinations of artificial intelligence techniques, the developer created algorithms and user interfaces to support automated parts predictions. While the specific artificial intelligence techniques are beyond the scope of this paper, they include case-based reasoning, object-oriented programming, knowledge-based development, and knowledge engineering. *Artificial Intelligence Techniques: A Comprehensive Catalogue* offers readers a complete look at the terminology and concepts of current artificial intelligence techniques (Bundy 1997).

One helpful way to describe the OPT's capabilities is by exploring its reactive and proactive functions. Reactive capabilities include its ability to evaluate by part descriptions. The OPT will perform forecast on a microcircuit technology given its text description. The description will be processed to determine the microcircuit's functional type, process technology, and packaging technology. The OPT will then analyze the information and output an evaluation.

Another reactive capability is evaluation by part number. Here, the OPT produces an evaluation for a part, given its manufacture's part number or National Stock Number (NSN). The capability to evaluate by weapon system allows users to import an entire weapon system's part numbers on a flat file and retrieve statistics on the overall status of the system. The OPT's capability of parts research provides technology and packaging information. At the same time, it will list alternatives to the given part. The list offers similar parts based on a fuzzy match of parts of similar technology and similar packaging.

The OPT's proactive capabilities include its process with Diminishing Manufacturing Sources (DMS) notices. Here, additional DMS notices for a given part will trigger a reevaluation of all its similar parts. Another capability is its automatic signaling process. The OPT identifies all loaded weapon systems affected by a part going obsolete. As the OPT migrates from running on a independent computer to a network arrangement, it will be able to employ its ability to automatically send action items to managers of systems with suspect parts.

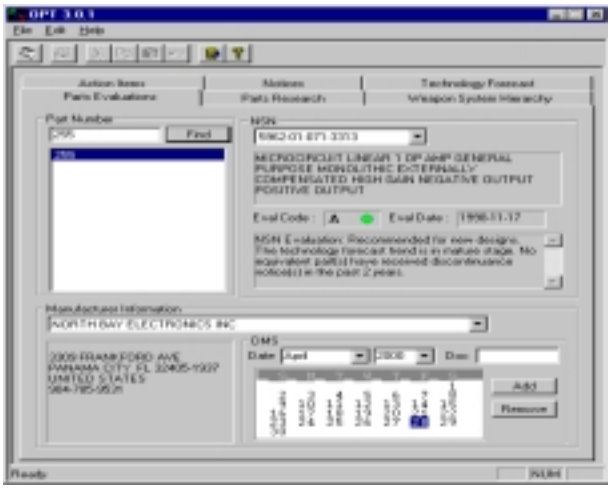

FIGURE 1. Parts Evaluation

Currently, the OPT's primary functions that will aid managers can be discussed by describing the

following core attributes: parts evaluation, parts research, weapon system evaluation, and technology forecast. Through the parts evaluations tab, managers can query the part descriptions and obsolescence status of a microcircuit part, as well as manufacturer and DMS notice information. The OPT has traditional search capabilities by part number. For instance, a user can search for part numbers by only entering a portion of a part number, or the user can use wildcard functions on searches. All of the outcomes from a search will be listed in the part number edit box, where the user can select the desired match. Figure 1 shows the information given on each matching part number.

The list of manufacturers corresponding to the selected part number is displayed in the manufacturer combo-box. The manufacturer's DMS issue date is presented in the DMS calendar. The listed DMS issuance date is defined as the date that Government and Industry Data Exchange Program (GIDEP) received the notice from the manufacturer. This date will be reflected in the calendar by a red highlight. This date does not indicate when that the part is expected to be discontinued. DMS notices can be added or deleted into the OPT's database by the "add" and "remove" buttons near the calendar.

Users select the parts research tab to find out the technical characteristics of a part and also the existence of alternative parts with similar features. Similar to the parts evaluation tab, users can enter the entire part number or a partial input with wildcard options.

Likely the most valuable tab for managers interested in evaluating system health, is the weapon system hierarchy tab. This allows users to perform bulk evaluation of parts. Users can import an entire list of part numbers through the "import" button found under the system evaluation tab. Currently, OPT only accepts lists saved as flat files. Weapon systems can currently be broken down into four levels: weapon system, module, unit and part. The top three levels serve as classification to describe the levels of hierarchy. The OPT's evaluation is done at the part level. The various levels can be manually added, deleted, or renamed. Once loaded, users can simply click the evaluation button to retrieve a summary for the entire weapon system. The data is displayed in a tree diagram fashion. Each part receives one evaluation status. The possible ratings include:

- Acceptable
- Suspect
- Near obsolete
- Obsolete
- Unknown category
- Not evaluated

Each evaluation is assigned a corresponding color to be more readable to the evaluator or manager. The evaluation can be sorted by evaluation code or by part number. Sorting by evaluation code allows managers to concentrate on the parts determined to be near obsolete and obsolete first. In a summary report, managers

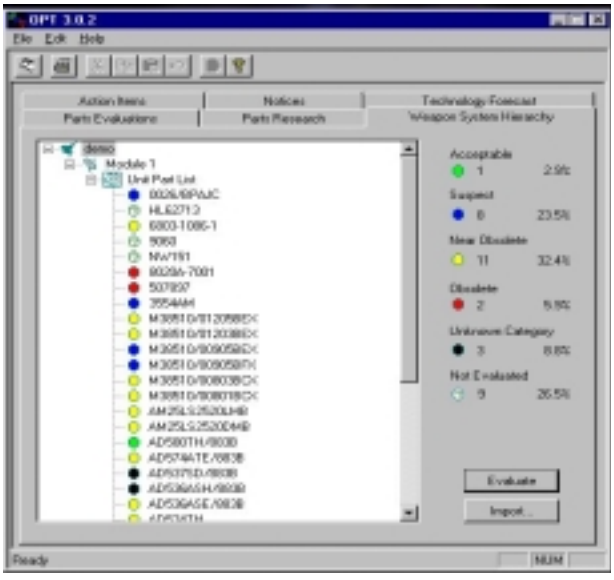

FIGURE 2. Weapon System Hierarchy

can instantly see what percent of their parts are in each evaluation category.

Each category corresponds to a specific obsolescence definition. Acceptable parts are

microcircuits that are considered acceptable in military applications. Suspect parts have availability forecast that may still be acceptable for new designs but should be done with caution. Near obsolete parts are at the end of their life cycle and are expected to become obsolete in 2 years. Obsolete parts are no longer available from the original manufacturer or alternate manufacturer. Parts that show the unknown category designation can be found in the OPT database, because of insufficient information to determine obsolescence categories. Some parts will not be evaluated because they could not be found in the OPT parts database or are too new to be evaluated. Many of the prototype OPT's demonstrations have had a majority of the parts categorized as not evaluated. This is primarily due to the aged and incomplete data set used as the OPT parts database. Discussed further in this paper, current improvements for the OPT include an updated database.

The technology forecast tab (see figure 3) allows users to perform microcircuit technology predictions based on any given description of a microcircuit family. The following descriptions can be entered into input text box:

- Functional descriptions of a microcircuit family
- Technology of a microcircuit family
- Descriptions of the microcircuit packaging used.

Six technology stages are used to describe each technology type. The values expressed in this scale are used in the explanations for microcircuit obsolescence status evaluations. Similar to the parts evaluation definitions, these stages also have specific descriptions clearly defining the boundaries of each stage. The stages are as follows:

- Introductory
- Growth
- Maturity
- Saturation

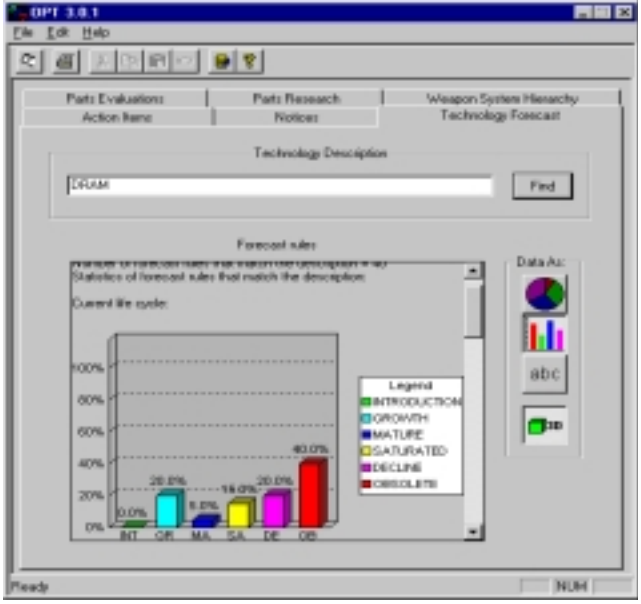

FIGURE 3. Technology Forecast

- Decline
- Obsolete

The current OPT has additional tabs to accommodate future improvements to its ability to act as in interactive tool between multiple users across a wide range of weapon systems.

The current OPT was written in C++ 5.0 programming environment. The user interface and a number of data processing utilities are built on top of Microsoft Foundation Class. The data access module was developed using Microsoft Open Database Connectivity Library (ODBC). The current OPT works with Microsoft Access. The OPT was built to be compatible with Windows 95, Windows 98, and Microsoft NT 3.51+ or higher operating systems (SHAI 6). As described in the following section, the OPT is currently being transitioned to a web-based environment to simplify use and strengthen NAVSUP's ability to distribute the OPT to users.

Future OPT

The future OPT is closely related to the current OPT prototype. One shortcoming of the current OPT is its dated and incomplete parts database and technology trends forecast. These have not been updated recently because the mechanics and algorithms of the OPT can be evaluated without current data. Updating the parts database and technology trends forecast information would have required an expense of

resources without any noticable benefit, since the OPT has not yet been distributed to users. As the tool becomes web-based, these crucial updates will be completed. To better understand the future OPT, the following describes the intended audience, the system architecture, and improvements process for the OPT.

The intended audience is two-fold: advanced and novice. Currently, there are successful commercial versions of obsolescence tools. The OPT was never created to replace these commercial tools or take away from their user base. Rather, the OPT offers more advanced users an additional tool for a sanity check to the currently used tools. Separate predictions simply offer engineers and managers an additional look at suspect parts.

The second segment of the audience includes those managers who have no regular interaction with predictive tools. This audience may have had little or no exposure due to the cost of commercial tools or simply no introductory exposure to predictive tooling. The web-based OPT will offer an introductory look into predictive tooling. These new users may decide that the OPT offers them the proactive notification necessary to prevent detrimental impacts from parts going obsolete. This introductory phase may also lead to an awareness of the need for additional commercial tools that expand beyond the capabilities of the OPT.

For pragmatic reasons, the OPT will initially be limited to DoD users, with the likelihood of later expanding the user base. While the OPT is still envisioned as a little or no cost tool, using agencies must pay for the amount of commercial data consumed. This cost is entirely a variable cost that is contingent on the amount of data collected by each agency.

The architecture of the web-enabled OPT requires certain interfaces to make the OPT accessible, updated, and operational. The interfaces must also allow proper metrics for tracking of data consumption and OPT usage. Figure 4 shows the proposed relationships between the needed entities to facilitate all of these requirements.

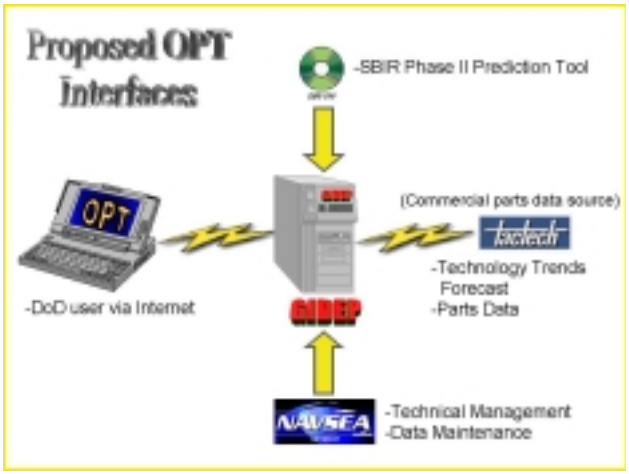

FIGURE 4. Proposed OPT Interfaces

GIDEP will serve as the web host for the OPT. It is a logical fit, since GIDEP is DoD's centralized database for DMSMS and is very experienced at web hosting and server maintenance. OPT users would log onto GIDEP with GIDEP user names and passwords. This will allow NAVSUP the administrative control to limit the use of the OPT and safeguard its use to DoD users.

This control feature is important to meter commercial data usage and to prevent the abuse of the access to the commercial data. Commercial data sources desire the security of knowing the limits of the audience to protect their proprietary interests. The commercial data usage will be purchased much like gas for a car. You buy X dollars worth of "fuel," and drive until you need more. The data is priced according to variables such as the required number of data fields, OPT user population, and number of concurrent OPT users. GIDEP's ability to track log-ins and usage by agency will allow the "fuel," or commercial data, to be billed to the appropriate agency. For example, if agency A uses $500 worth of data and agency B uses $20,000 worth of commercial data, each would pay the appropriate amount, rather than a general cost-sharing arrangement. Future agencies would have to engage in similar

arrangements contingent on commercial data restrictions and GIDEP eligibility.

The OPT will be technically supported by the Naval Sea Systems Command, Division Keyport. Keyport's personnel have been involved with the OPT since its inception. Primary responsibilities include technical management, data maintenance, improvement integration, and general technical support. Keyport is taking a lead role in the OPT's migration to a web-enabled tool.

Following the initial period of when the OPT becomes web-enabled, user input may lead to improvements to the current OPT. Evaluations to date have praised the OPT for its intuitive design, output format, and overall usefulness. A NAVSUP operational test report dated March 1999 speaks of the OPT's "quick and easy method of giving a snapshot of the technological health of a system's components" (Koleck 3). A comprehensive test and review conducted by the Air Force Material Command dated July 1999 reports that the OPT identified 98.3% of the NSN data and 84% of the part number data (Neely 1). Additionally, the report praises its intuitive design and ease of usage. Recommended changes have remained largely cosmetic in nature.

Needed improvements that have been identified after the initial web-based period can form the basis of the statement of work for a final phase III contract with the OPT software developer. This initial period will allow rich feedback that often escapes the environment of early prototype testing.

OPT in the Big Picture

The battle to minimize the effects of obsolescence and DMSMS will likely be around forever. As managers of highly technical materiel that must be in service longer than in commercial applications, we find ourselves even more prone to the effects of obsolescence. Exciting technical hardware and software solutions have been proposed to combat many obsolescence nightmares. Tracking systems have been organized to optimize the resulting synergies created from information sharing and DMSMS case tracking. However, managers will always need the earliest notification possible to focus their attention and cadre of solutions in the right area and at the right time. The OPT is a tool that can help managers and engineers prioritize the approaching obsolescence problems and gain the earliest possible warning. The OPT can play a lead role in the initial DMSMS resolution step; identification and notification. After a successful introduction and regular role in problem identification, the OPT can lead developers to improvements of other obsolescence prediction tools or predictive tools aiding managers with the resolution steps beyond the initial identification and notification step. Artificial intelligence and well-crafted algorithms will likely have larger roles in aiding managers with case analyses, resolution selection processes, and implementation planning.

Conclusion

The OPT offers both seasoned and novice managers a tool to proactively battle the daunting repercussions of obsolescence on weapon systems. Some managers will use the tool as their first look into predictive tooling, and others will use the tool as a double check to existing processes. This NAVSUP-developed tool offers managers a user friendly interface used primarily for parts evaluation, parts research, weapon system evaluation, and technology forecast. The developing web-interface will allow for the widest dissemination to DoD users. Its interface with a commercial data source, experienced web host, and government engineering agency will ensure that the OPT remains accessible, current, and operational. The existing interfaces will also allow for process improvements after an initial period of DoD usage. The OPT's final implementation is designed for an active role in the identification and notification step of DMSMS resolution. The success of this prediction tool will likely fuel the interest to design and produce a larger cadre of tools, which will aid managers with even more

applications to the phases of weapon systems' life cycles. A challenge for the very near future is the management task of bundling the developing tools into a one-stop shop for managers. This bundling will require an aggregate integration of common databases, related tools, technical documentation, and applications facilitating collaboration between managers and engineers, as well as an integrated interface and marketing plan to help standardize an optimal engineering and management tool set.

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